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ABSTRACT

A research design, decision support system, and results of a comparative analysis of enrollment and financial strength (of private institutions granting masters and doctoral degrees) are presented. Cluster analysis, discriminant analysis, multiple regression, and an interactive decision support system are used to compare the enrollment and financial strength of a private comprehensive university with selected peer and aspiration institutions. The study was initiated to assess how rapidly the university can increase faculty salaries considering its financial resources and its risks as a tuition- and enrollment-dependent institution. The decision support system developed for the study is part of a long-range effort to improve the quality of information available for strategic planning and financial management at the university. The use of a hybrid method of selecting peer and aspiration groups was found to be a practical approach. Cluster analysis, discriminant analysis and multiple linear regression were found to be powerful tools for analysis and presentation of interinstitutional data. The decision support system was found to be extremely use in refining and interpreting the results of the analyses through a case-study approach, and can be used with any institutional research database. Contains 5 references. (Author/KM)

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COMPARATIVE ANALYSIS OF ENROLLMENT AND FINANCIAL STRENGTH OF PRIVATE INSTITUTIONS

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Teresa Karolewski
Chair and Editor
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Abstract

This paper presents a research design, decision support system and results of a comparative analysis of enrollment and financial strength of private institutions granting masters and doctoral degrees. Cluster analysis, discriminant analysis, multiple regression and an interactive decision support system are used to compare the enrollment and financial strength of a private comprehensive university with selected peer and aspiration institutions in the private sector. The study was initiated to assess how rapidly the university can increase faculty salaries considering its financial resources and the risks involved as a tuition and enrollment dependent institution. The decision support system developed for the study is part of a long range effort to improve the quality of information available for strategic planning and financial management at the University.

Introduction and Perspective

As a private comprehensive university that is tuition and enrollment dependent, the University of Hartford over the next several years faces the difficult task of balancing institutional prices, student aid policy, and pressures for higher faculty and staff salaries against several realities: declining numbers of high school graduates, increasing competition for students, increasing resistance to tuition increases and rising institutional costs.

The major private research universities and selective liberal arts colleges, by virtue of their long history, prestige and reputations for academic excellence, can charge higher student prices, select only qualified students, attract resources from diverse sources and achieve levels of affluence that permit paying higher faculty salaries. But tuition and enrollment dependent private institutions face much greater risks in balancing institutional prices, enrollment size and admission selectivity against many competing demands for funds and relatively limited income sources as they seek to raise faculty salaries.

Purposes of the Research

The research summarized in this paper was designed to accomplish two major purposes:

1. Develop a method for selecting appropriate peer and aspiration groups a private comprehensive university can use to assess the institution's enrollment and financial strength and its ability to pay higher faculty salaries.

2. Build a decision support system to simplify the process of applying data, statistics and judgment to perform interinstitutional comparative studies of enrollment and financial strength.

The paper starts with a brief review of the literature on interinstitutional comparison studies and an overview of the conceptual framework used in the research design. It proceeds with a description of the data sources and the statistical analysis methods used to identify and validate peer and aspiration groups of institutions and to predict average faculty salaries from enrollment and financial variables. The decision support system and interactive computing are described as effective tools to clarify and refine understandings about differences in enrollment and financial strength among institutions. Finally, this is followed by an analysis of the results of the study, reporting on differences observed between institutional groups and between the University of Hartford and its peer comparison group.

Literature Review

A comprehensive review of the literature of interinstitutional comparisons in higher education was published in 1987 (Brinkman, 1987). Brinkman cited the growing interest in interinstitutional comparisons and expressed the belief, shared by many administrators and analysts, that such comparisons among institutions can be a valuable management tool. However, the selection of peer and aspiration groups and the analysis of comparative data are often complex and risky, and few administrators and analysts in higher education have the necessary background to conduct and interpret the results of interinstitutional comparison studies.

Much of the early work on interinstitutional comparisons was motivated by pressures for accountability from legislators and state wide coordinating boards in the public sector. Planners and institutional researchers who have participated in interinstitutional comparison studies at the public system or state level express concern about the political, institutional control and technical aspects of interinstitutional comparison studies (Teeter, 1983; McCoy, 1987).

Nevertheless, interest in interinstitutional comparison studies continues to grow. The number of primary and secondary sources of interinstitutional comparison data is increasing, and applications and methods for comparative analysis are improving, notwithstanding known limitations regarding the timeliness and comparability of data and the lack of theoretical frameworks for the design of such studies (Christal and Wittstruck, 1987; Whitely and Stage, 1987).

As institutional uses of comparative data become more prevalent, the issue of how to select college or university peer and aspiration groups becomes more important. To address this need, a number of colleges and universities, both public and private have engaged in voluntary data sharing consortia to reduce the redundancy of effort in responding to requests for information, to produce greater cross-institutional uniformity of data categories and definitions, to reduce the risks and costs of major survey projects, and to enhance the legitimacy of comparison studies both on campus and externally (Dunn, 1987).

Brinkman and Teeter (1987) described a topology of procedures used to develop peer groups for interinstitutional analyses ranging from formal statistical methods like cluster analysis, to hybrid approaches, threshold approaches or panel reviews. Panel reviews and threshold approaches rely on institutional classifications based on mission, governance, and enrollment size and on qualitative and subjective judgements about reputation and competitive standing. Statistical methods like cluster analysis are more objective, but still require judgement in selecting samples of institutions, identifying the critical variables, and deciding where to set boundaries between groups of institutional cases as they are arrayed in a cluster analysis.

Recent work by the Association of Governing Boards and NACUBO provides a conceptual framework for strategic planning and financial self-assessment that improves on the resources available for designing interinstitutional comparison studies (Frances et al., 1987; Gale and Finn, 1985; Dickmeyer and Hughes, 1987). Based on the literature review and an assessment of alternatives, we decided on a hybrid approach that incorporated a combination of informal judgements about institutional typologies, more formal and objective statistical analysis methods, and a case study approach using an interactive decision support system specifically designed for the project.

Conceptual Framework for Research Design

Figure 1. displays relationships among the major components of the research design and the variables and ratios in each component that contribute to enrollment and financial strength, which in turn influence an institution's ability to pay higher faculty salaries.

Comparative Analysis of Enrollment and Financial Strength of Private Institutions Granting Masters and Doctoral Degrees

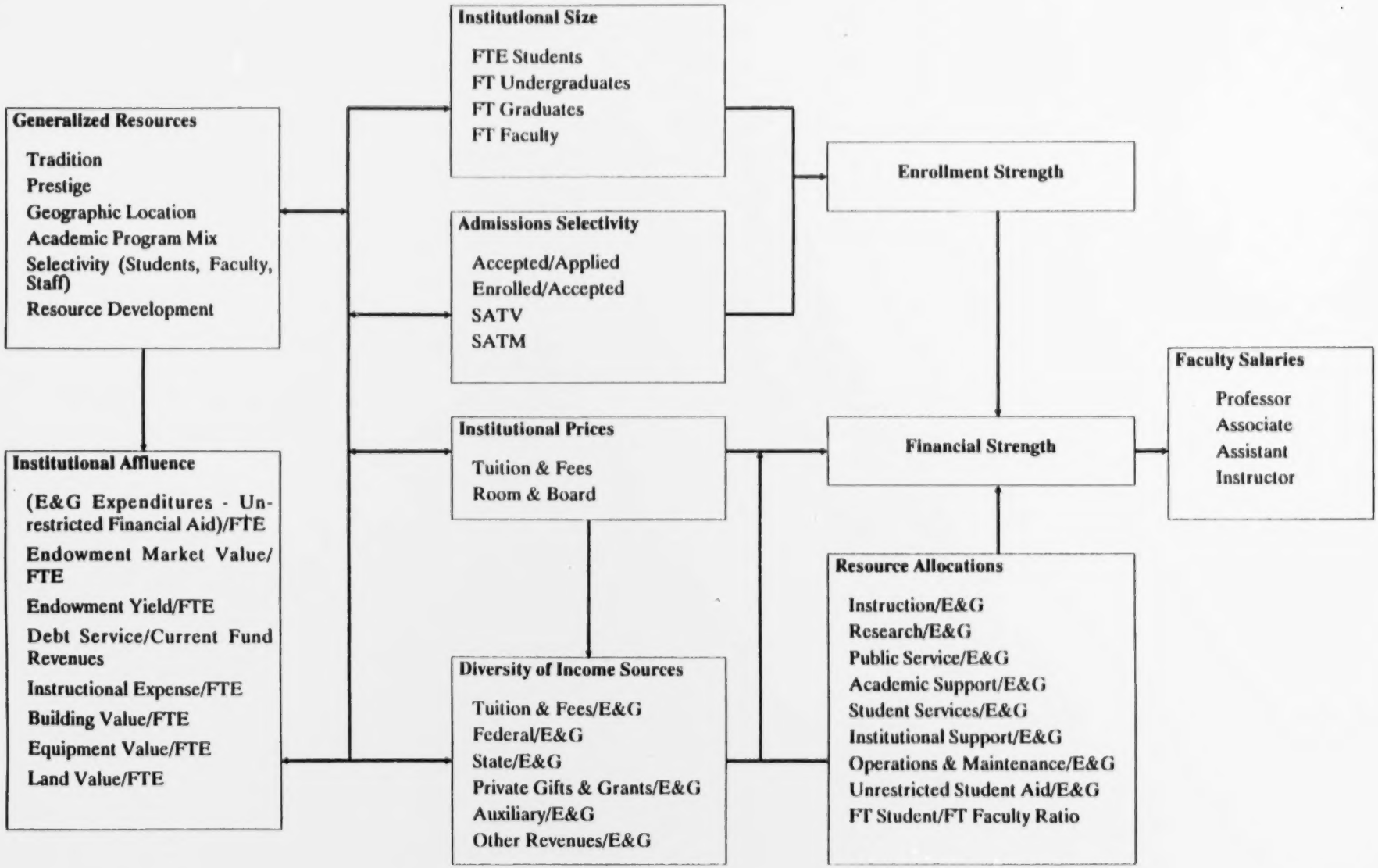

Figure 1.

Enrollment strength is dependent on institutional size and admissions selectivity, as the joining lines and arrows in the model indicate. Institutional size, the number and mix of students relative to the size of the faculty, serves as one buffer against declining enrollment demand. The second buffer against enrollment decline is admissions selectivity as measured by average College Board SAT scores, the ratio of acceptances to applicants and the ratio of enrolled to accepted applicants (i.e., admissions yield).

Financial strength is most directly influenced by enrollment strength, institutional prices and the extent to which an institution's Educational and General revenues are diversified rather than being concentrated primarily on tuition and fee and auxiliary enterprise income, which are enrollment driven. An institution's financial strength and its ability to pay higher faculty salaries are both contingent on the level, diversity and flexibility of funding sources, especially income from endowment, annual giving, sponsored research, federal and state scholarship programs and net revenue from ancillary enterprises.

Financial strength and available funds to pay higher faculty salaries are also a function of resource allocation, faculty and staff productivity, and efficiency of operations achieved through cost containment. The major issue is the balance of Educational and General Expenditures among mission related activities (i.e., instruction, research and public service) and support activities (i.e., academic support, student services, institutional support, and operations & maintenance). But other important resource allocation issues that must also be considered in the research design

are faculty productivity (as measured by student/faculty ratios or credit hours per faculty member) and the extent to which student financial aid is funded using unrestricted operating funds (i.e., in effect as a tuition discount) as opposed to using endowment income or external funding.

Enrollment demand and faculty staffing, as measured by student/faculty ratios and student credit hours produced, are critical factors in the survival and financial strength of tuition and enrollment dependent institutions, especially for small private colleges with limited academic offerings. The major sponsored research universities and selective liberal arts colleges are largely insulated from declining enrollment demand because their prestige and reputations for quality in academic programs and campus life attract many more qualified applicants than places in the entering class, because they can charge higher tuition and fees (i.e., quality or status is perceived to be worth the high costs), and because they have abundant student aid to offer needy, talented students. For sponsored research universities and selective liberal arts colleges, the threats to financial strength are more likely to be caused by economic downturns rather than by enrollment decline (e.g., reductions in federal and corporate funding of sponsored research, failure of federal and state aid programs to keep pace with rising student costs, or annual giving programs and endowment yields not keeping pace with rising institutional costs).

Prestige and tradition are generalized resources that an institution can build only over an extended period of time by establishing a reputation for distinctive competence through the

quality of its academic programs and campus life. Institutional prestige and tradition are assessed qualitatively on the bases of the visible accomplishments of faculty, students, alumni and staff and the loyalty that derives from their satisfaction as members and constituents. An institution's geographic location may be favorable or unfavorable for acquiring resources because of its sphere of influence (local, regional, national, international), its population density (urban, suburban, rural), demographic trends (growth, stability, decline) or economic conditions (e.g., economic growth, per capita income, employment rate). Having a mix of academic programs that are socially valued and in high demand enables an institution to be selective in choosing its students, faculty and staff and in acquiring resources and funds on terms that are favorable to the institution.

Institutional affluence is a function of an institution's year of establishment, its ability to acquire resources and its success in conserving resources to invest in future growth and development. Increasing affluence is necessary to increase the size, quality and flexibility of an institution's endowment, land, buildings, and equipment, and to increase instructional resources relative to the size of its student enrollment, faculty and staff. Finally, the institution must maintain a favorable equity position, keeping its debt service payments and current fund revenues in a favorable balance, and weighing opportunities for growth and improvement against the requirement of prudent financial management.

Data Sources

Electronically encoded data from the 1985 HEGIS financial survey were obtained from Minter's Higher Education Data Service for all private institutions granting masters and doctoral degrees. Information on institutional prices, admissions selectivity and institutional size were gathered from the College Board's annual survey of colleges and universities. Faculty salary data were gathered from the AAUP report on Economic Status of the Profession. The data were assembled and integrated in a Foxbase database on an IBM AT personal computer, and standard enrollment and financial ratios were computed using the NACUBO financial self-assessment indicators.

Statistical Analysis Methods

First, private institutions granting masters and doctoral degrees were selected as the appropriate institutional reference group for the University. A selection was then made on the basis of full-time equivalent enrollment size, placing all institutions having enrollments under 3,000 in one group and all those over 3,000 in the other group.

The University of Hartford comparison group was identified by performing a cluster analysis of enrollment and financial ratios of the over 3000 FTE enrollment group using SPSS-PC. Cluster analysis is a procedure that separates cases into mutually exclusive groups based on the values of each case on a set of specified variables. The procedure begins by placing one case in a separate group. It then creates another group by separating the remaining cases, and continues to separate groups until each case is in a group of its own. While the procedure is separating off new groups, it is attempting to make each group as internally

homogeneous and as distinct from the other groups as possible given the variables used.

For this cluster analysis, the data base included all private, comprehensive institutions and research universities in the United States with FTE enrollment between 3,000 and 10,000, augmented by a list of institutions that the University had used for interinstitutional comparisons in the past. We selected points in the analysis at which the group separations created a reasonable size group that included the University. To test the validity of that group distinction and to see which variables distinguished those institutions from the others used in the cluster analysis we ran a discriminant analysis, also in SPSS-PC.

Discriminant analysis works in the opposite way from cluster analysis. It takes already identified groups and determines which variables make the groups different and assesses how accurately those variables can predict group memberships. According to the discriminant analysis, the variables most useful for distinguishing the University of Hartford comparison group from the rest of the institutions were, in descending order

- tuition and fee income
- applied to accepted ratio
- endowment income
- financial aid expenditures
- institutional support expenditures
- research expenditures
- accepted to enrolled ratio
- private gifts and grants revenue
- state support revenues.

Clearly, variables that measure each institution's revenue dependence and margin of admissions selectivity are important elements that distinguish the University of Hartford comparison group from the other set of colleges and universities.

Discriminant analysis then uses an equation based on the identified variables to predict group membership for each case and then checks the predicted group membership against the actual group classification for all cases. In this analysis, the procedure correctly assigned 96.5 percent of the institutions to their appropriate groups, indicating that the cluster analysis produced two highly distinguishable groups of institutions and that nine variables identified in the cluster analysis provide a high degree of accuracy in predicting the group to which an institution belongs.

Multiple linear regression was used to identify which variables predict average levels of faculty salaries by academic rank across all three groups of institutional cases. The analyses produced multiple correlations of .95 for professors, .87 for associate professors, .85 for Assistant professors, and .91 for instructors. As expected, the faculty salaries were highly correlated with the enrollment and financial strength of the institutions included in the analysis.

Finally, a decision support system (DSS) was built to refine the analysis of interinstitutional comparisons on the basis of case study reviews. A description of that decision support system is presented in the next section of this paper.

Decision Support System

A decision support system (DSS) was built to employ interactive computing as a tool for clarifying and refining observations about differences in enrollment and financial strength between the University of Hartford and its peer and aspiration groups. The DSS is a user-friendly system of menus and screens that can be used with a data dictionary to analyze and prepare reports from the institutional database without having to write a computer program. Using Foxbase data base software (i.e., a dBase III compatible C compiler) for the IBM AT personal computer, the DSS makes effective use of macro and report-form facilities to simplify reporting and to give the user maximum flexibility in specifying report requests.

The user enters DO FINREPT in Foxbase to access the main menu of the DSS and is given three reporting choices:

1. Print selected listing reports
2. Perform rankings for selected variables
3. Compare one institution with another.

Having selected one of these three report options, the user is then given an opportunity to request a printed copy of the data dictionary for the interinstitutional comparisons data base. The data dictionary provides a field name and description of each data field and its attributes (i.e., character or numeric, width of field and decimal positions) grouped according to the model components presented in Figure 1.

With the listing reports, the user can enter a record selection statement to specify the criteria for including institutions in the report, the data field(s) to be used in sequencing the

institutional case records, and which combination of variables to print in the listing (i.e., select a report form). For example, the user wants to include all institutional records where the ratio of tuition and fee income to Educational and General Expenditures is greater than > .75, to sequence the records in the listing by that same ratio, and to print the variables that show revenue sources as ratios to Educational and General Expenditures. To retrieve this information, the user selects the listing report option on the menu, enters the record selection statement (tuitfees > .75), the sort sequence (tuitfees) and a (1) to select the appropriate report form (Revenue Ratios to Educational and General Expenditures is selection #1).

The same menus and screens used for the listing reports are also used for specifying record selection and the sort sequence for variable rankings. With this choice, the institutional cases are ranked on the selected variable, and a rank listing is printed. One useful option is to select the sequence variable that is computed from the discriminant function values as the variable used to rank the institutional cases. This identifies those institutions that over all significant variables are most similar on enrollment and financial strength. The ranking feature also can be used within specified record selection criteria and ranges on the ranking variable to compute the relative standing of any institution in your peer or aspiration group (e.g., on tuition cost, ratio of accepted students to applicants). Along with each ranking, the DSS computes the mean, standard deviation, maximum and minimum values for the selected data field for all records satisfying the users record selection criteria.

Finally, the user has the option to perform a case by case comparison for all types of enrollment and financial variables. Having selected option three in the main menu, the user only needs to enter the institutional identification code (i.e., FICE code) for each institution, and the computer produces a side be side comparison of each variable one screen at a time and sends that view to the printer. The comparison report parallels the organization of variables presented in the model (Figure 1.) and the data dictionary used in the system. The case by case comparisons are especially useful in explaining some of the subtle differences among institutions in enrollment and financial strength.

Intergroup Comparisons

Having divided the sample of 221 private institutions into two groups based on enrollment size, cluster analysis was used to array the institutions in the 3,000 and above enrollment group on measures of enrollment and financial strength. Discriminant analysis was performed using the under 3,000 enrollment institutions with the two groups of larger institutions created in the cluster analysis. The three institutional groups were about equally represented in the sample of 172 institutions with usable data.

The three institutional groups are identifiable both by name and statistical profile as predominantly: 1) Private Research Universities, 2) Private Comprehensive Universities, and 3) Small Private Colleges.

Private Comprehensive Universities, the group that included the University of Hartford, has enrollments that were less than half the enrollment size of Research Universities and nearly three times the average enrollment of the Small Colleges.

Admissions selectivity (i.e., the ratio of accepted to applied students) was significantly higher at the Research Universities (.55) relative to the other two groups (.72), but admissions yield (i.e., ratio of enrolled to accepted students) was very similar across groups (range .42 to .46).

Institutional prices were significantly higher at the Research Universities; about $2,100 higher for tuition and fees and about $600 higher for room and board relative to the average prices for Comprehensive Universities and Small Colleges.

The ratio of tuition and fee income to Educational and General (E&G) Expense indicated a very concentrated dependence on tuition and fees at Comprehensive Universities (.77) and Small Colleges (.69). Auxiliary Enterprises income, also driven by student enrollment and fees, represented a significant percentage (between .16 and .20) of the remaining income sources available to Comprehensive Universities and Small Colleges (except, of course, for institutions having large commuter populations). Income to E&G Expense ratios at Research Universities revealed a much more diversified pattern of income sources: tuition and fees (.48), federal gifts and grants (.20) and other revenues (.42). Federal gifts and grants and other revenues (e.g., from hospitals, research centers) at Research Universities were proportionately higher, about double the comparable ratios of the Comprehensive Universities and Small Colleges.

Based on dollar values per full-time equivalent students, Research Universities were on the average between two and five times more affluent than Small Colleges and Comprehensive Univer-

sities depending on the measure selected. Small Colleges were about 20 percent higher than Comprehensive Universities on most of the selected affluence indicators. The variables divided by FTE students to compute the dollar-value per full-time equivalent student were: endowment book value, building value, equipment value, E&G expense less unrestricted aid, instructional expense and endowment yield. Student/faculty ratios at Research Universities (13.5 to 1) and at Small Colleges (14 to 1) were also significantly lower than the corresponding ratio for Comprehensive Universities (17.5 to 1).

The resource allocation pattern among the three groups also reflected differences in mission focus and economies of scale. Overall the three groups of institutions spent between .38 and .42 of their E&G expenditures on instruction, between .08 and .10 on academic support, between .09 and .11 on operations and maintenance, and between .06 and .08 on student aid. However Research Universities allocated .17 of their E&G expense to research, whereas only .01 to .02 was allocated to research expense in Comprehensive Universities and Small Colleges. From the resource allocation ratios for institutional support and student services it is clear that Research Universities and Comprehensive Universities, because of their larger size, have certain advantages in economy of scale over Small Colleges.

As expected from the admissions selectivity, income diversity, affluence and resource allocation patterns, average faculty salaries were much higher at Research Universities than at Comprehensive Universities and Small Colleges among private institutions offering masters and doctoral degrees. Average faculty

salaries for professors at Research Universities were 18 percent higher than for professors at Comprehensive Universities and 31 percent higher for professors at Small Colleges. The same pattern of differences in average faculty salaries among institutional groups is indicated for the other academic ranks (associate professor, assistant professor, instructor), except that the percentage differences were somewhat smaller. Average faculty salaries for the other academic ranks were about 10 percent lower for Comprehensive Universities and about 20 percent lower for Small Colleges relative to average salaries for comparable academic ranks at Research Universities.

Institutional Peer Group Comparisons

The University of Hartford and thirty-five institutions were selected on the basis of the cluster analysis as the peer comparison group for assessing differences in enrollment and financial strength.

The University of Hartford ranks significantly below the medians for the peer comparison group on measures of admissions selectivity, ratio of accepted to applied students, ratio of enrolled to accepted students, and average College Board SAT Verbal and Math scores. Hence the University has less flexibility in maintaining its enrollment levels and standards of academic quality in the event of declining numbers of admissions applicants.

The University's institutional prices for tuition and fees were slightly above the average for the peer comparison group, but its room and board charges ranked near the top of the group (about 20 percent higher than the peer group average). The Uni-

versity ,at that time, therefore, was more constrained than its peers in raising institutional prices to compensate for any income loss that might result from unanticipated declines in enrollment.

The University of Hartford's full-time equivalent student enrollment was slightly above the median for the peer comparison group and was above average for full-time and part-time undergraduate enrollments and for part-time graduate enrollments. The University was below the average enrollment for the peer group for full-time graduate students. Generally, the larger the student enrollment, and the greater the diversity of academic programs (assuming reasonable demand), the more flexibility the institution has to sustain its enrollment levels in periods of declining demand. However, program diversity through curriculum proliferation and enrollment declines, can result in less than optimal efficiency and quality in some academic programs, especially in a small university. The size of the full-time faculty at the University ranks in the top third of the peer comparison group, reflecting in part the lower student/faculty ratios required for instruction in some of its programs, including: art, music, engineering and electronic technology.

All of the institutions in the peer comparison group have a concentrated dependence on tuition and fee and auxiliary income as revenue sources. The average ratio of tuition and fee revenues to E&G expenditures is .79, and for auxiliary enterprises income the average ratio to E&G expense is .17 for the peer comparison group. The corresponding ratios for the University of Hartford are about one percent lower for tuition and fees and

about three percent higher for auxiliary enterprise income. However the University spent more on student financial aid from unrestricted funds (11.7 percent of E&G expense) than the average for the peer comparison group (8.0 percent of E&G expense).

Generally, the University spent a higher percentage of its E&G budget on mission related activities than average for the peer group; proportionately 4 percent more for instruction, 1.7 percent more on research, and 1.0 percent more for public service. The University spent proportionately less than the peer group on academic support (4.6 percent less), student services (3.2 percent less), and institutional support (1.5 percent less).

On the average dollar value to FTE enrollment ratios, (the indicators of institutional affluence in Figure 1.),the University of Hartford ranked higher than its peer group on instructional expense, equipment, and E&G expenditures, but below the peer group averages for land, buildings, endowment value, and endowment yield.

In recent years, the University of Hartford's average faculty salaries as a percentage of peer group averages have ranged between 6.2 percent to 9.8 percent below the average for professors, and between 4.0 percent and 8.1 percent below the average for associate professors and assistant professors. Through repeated analyses of enrollment, financial and faculty salary data for peer comparison groups, the University has gained a better understanding of its enrollment and financial strength and of the opportunities and limits it faces in its efforts to offer more competitive faculty salaries.

Conclusions

The use of a hybrid method of selecting peer and aspiration groups is a practical approach to the problem, and cluster analysis, discriminant analysis and multiple linear regression are powerful tools for analysis and presentation of interinstitutional data. The decision support system is extremely useful in refining and interpreting the results of the analyses through a case study approach, and it is an analytical tool that can be used with any institutional research database. The results of the comparative analysis of enrollment and financial strength were employed at the University of Hartford to identify peer and aspiration groups, and findings from the study were incorporated into a major report that related the university's enrollment and financial strength to its ability to pay higher faculty salaries.

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